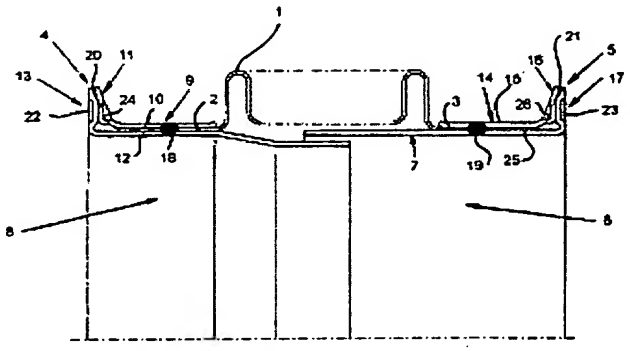
METAL EXPANSION JOINT AND VIBRATION ABSORBER APPARATUS FOR PIPE SYSTEMS

Publication number: EP0826126
Publication date: 1998-03-04
Inventor: MANTOAN SILVANO (CH); PETERMANN WERNER (CH)
Applicant: BOA AG (CH)
Classification:
- International: ***F16L27/11; F16L27/12; F16L51/02;*** **F16L27/00; F16L27/12; F16L51/00;** (IPC1-7): F16L51/02; F01N7/18
- European: F16L27/11; F16L51/02J
Application number: EP19960911086 19960510
Priority number(s): WO1996IB00441 19960510; US19950442689 19950517

Also published as:
WO9636833 (A1)
US5542715 (A1)
EP0826126 (A0)
EP0826126 (B1)
PL179994B (B1)

Abstract not available for EP0826126
Abstract of corresponding document: **US5542715**

The apparatus includes a first protection sleeve element having a substantially radially upturned annular end portion, a second protection sleeve element having also a substantially radially upturned end portion and a bellows. The bellows ends at both sides in a neck. A cylinder shaped portion of the first protection sleeve element is surrounded by an envelope part having a cylinder shaped portion and a substantially radially upturned annular end portion. Likewise, a cylinder shaped portion of the second portion sleeve element is surrounded by an envelope part having a cylinder shaped portion and a substantially radially upturned annular end portion. The necks of the bellows are sandwiched between the cylinder shaped portions of the respective envelope parts and the first protection sleeve element and the second protection sleeve element and are welded thereto. The upturned end portions of the respective envelope parts and the first and second protection sleeve elements contact each other and form the flanges of the apparatus.



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 826 126 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
23.06.1999 Bulletin 1999/25

(21) Application number: **96911086.5**

(22) Date of filing: **10.05.1996**

(51) Int Cl.[6]: **F16L 51/02**, F01N 7/18

(86) International application number:
PCT/IB96/00441

(87) International publication number:
WO 96/36833 (21.11.1996 Gazette 1996/51)

(54) METAL EXPANSION JOINT AND VIBRATION ABSORBER APPARATUS FOR PIPE SYSTEMS

KOMPENSATOR UND SCHWINGUNGSDÄMPFER AUS METALL FÜR ROHRLEITUNGSSYSTEME

JOINT DE DILATATION MÉTALLIQUE ET APPAREIL ABSORBANT LES VIBRATIONS POUR RESEAUX DE TUYAUTERIE

(84) Designated Contracting States:
CH DE DK ES FI FR GB IT LI NL

(30) Priority: **17.05.1995 US 442689**

(43) Date of publication of application:
04.03.1998 Bulletin 1998/10

(73) Proprietor: **Boa AG**
CH-6023 Rothenburg (CH)

(72) Inventors:
- **MANTOAN, Silvano**
  CH-8804 Au (CH)
- **PETERMANN, Werner**
  CH-6020 Emmenbrücke (CH)

(74) Representative: **Blum, Rudolf Emil Ernst et al**
c/o E. Blum & Co
Patentanwälte
Vorderberg 11
8044 Zürich (CH)

(56) References cited:
US-A- 2 712 456
US-A- 4 047 740
US-A- 4 106 798
US-A- 5 159 811
US-A- 5 480 194

EP 0 826 126 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a metal expansion joint and vibration absorber apparatus for pipe systems according to the preamble of claim 1.

[0002] Metal expansion joints and vibration absorber apparatuses in pipe systems are predominantly used in two applications. A first application is the use of such apparatuses as expansion joint and a second application is the use as vibration absorber. In both applications the basically same design of the apparatus is used, whereby in case of expansion joints the primary operation of the apparatus is taking up displacements of pipes in a pipe system whereby such apparatus absorbs due to its design comprising a metal bellows element as secondary effect also possible vibrations in the pipe system. In case of vibration absorption the primary operation of the apparatus is absorbing vibrations in a pipe system whereby such apparatus takes up displacements of pipes in the pipe system as secondary effect. Also possible are applications in which the apparatus is used to take up displacements and simultaneously to absorb vibrations. The basic operating member of these apparatuses is its metal bellows which is calculated and designed regarding material, dimensions, etc. depending from the prevailing object, namely to absorb pipe displacements or then to absorb vibrations.

[0003] When such apparatus is used as pipe displacement absorbing apparatus it is called expansion joint.

[0004] Expansion joints are commonly used in pipe lines, pipe line systems and circuits in which for instance due to high or low temperature of the commodity flowing through the pipes the temperature of the pipes themselves increases or decreases accordingly leading to thermal expansions or contractions, resp. These expansions or contractions, resp. cause generally changes of the axial dimension of the pipes and also angular movements and lateral shifting displacements. In order to take such displacements up expansion joints are inserted between the pipe sections, whereby the metal bellows of these joints contract and expand such to take up mentioned changes of the dimensions.

[0005] The object of vibration absorbers is the absorption of vibrations in pipe systems in that the metal bellows absorbs vibrations or oscillations, resp. caused by the commodity flowing in the pipe system (turbulence), or vibrations stemming from a machine to which pipes are coupled, e.g. compressors or internal combustion machines, whereby in the latter case the exhaust pipe or manifold is coupled via such a vibration absorber to the machine.

[0006] Metal expansion joint and vibration absorbing apparatuses have commonly included a single or multiple bellows element made of a thin sheet of metal and formed with convolutions, which sheet metal bellows element is mounted e.g. by welding, soldering or clamping at both its ends to respective flange elements, via which the expansion joint or vibration absorber, resp. is coupled at both its ends e.g. via bolts or clamps to an adjacent pipe section of a pipe system or machine, resp. In order to protect the bellows from the commodity or fluid, resp. flowing through the apparatus and also to avoid turbulences in the fluid a protection sleeve can be arranged inside the bellows which extends coaxially thereto. This protection sleeve is generally mounted in one or the other way to one of the flanges. It may have an upturned end sandwiched between the flange of the expansion joint or vibration absorber, resp. and the flange of an adjoining structure, e.g. pipe, or it could be welded to the flange of the expansion joint.

[0007] Thus, the known expansion joints or vibration absorbers, resp. are assembled of a plurality of parts of various structural and physical properties. Accordingly, a manufacturer must keep a rather large amount of different articles for assembling such apparatuses in stock, the assembling of the apparatuses is time-consuming because a plurality of individual articles must be assembled and finally, specifically due to the solid flanges, the known expansion joints and vibration absorbers, resp. have a relatively considerable weight.

[0008] The US-A-4,106,798 discloses a representive example of a expansion joint having solid flanges as claimed in the preamble of claim 1. The necks of the metal belows element disclosed in the US-A-4,106,798 are sandwiched between respective flanges and short, cylinder shaped portions of sheet metal, but the cylinder shaped portions and the necks are welded to relatively thick, heavy flanges.

[0009] The US-A-5,159,811 discloses a coupling device having a metal bellows of which the necks are clamped between a massive flange portion and a heavy, massive clamping ring.

[0010] Both of the above structures are of a heavy weight and give rise to considerable production costs.

[0011] The invention as claimed is intended to provide a remedy. It solves the problem of how to design a metal joint and vibration absorber apparatus for pipe systems, in which a maximum of the parts may be of an identical sheet material.

[0012] The advantages offered by the invention are mainly that such apparatus is of an extremely light weight and can be produced more efficiently and, therefore, at low costs, or alternatively can be assembled cf several individual parts of differing thickness and physical properties to cope with prevailing conditions of operation.

[0013] One way of carrying out the invention is described in detail below with reference to drawings, which illustrate only one specific embodiment, in which:

Fig. 1 is a schematic view of a longitudinal section through the upper half of a preferred embodiment of the invention; and

Fig. 2 is a schematic sectional view on a somewhat enlarged scale of the left hand flange area of the

embodiment shown in Fig. 1.

[0014] The apparatus shown includes a metal bellows element 1 made of a thin flexible sheet metal which has been formed to have the illustrated convolutions. The metal selected can be any kind of metal having the prerequisite flexibility when deformed and possibly selected to withstand the pressure, temperature and also possible chemical attacks of the fluid it comes in contact with.

[0015] The bellows element 1 illustrated in the drawings is of a single-ply design. Obviously, this bellows element 1 could be of a multi-ply design as also commonly known in the prevailing art. The bellows element 1 ends at its left end in a first neck 2 and at its right end in a second neck 3 according to commonly known designs of bellows.

[0016] A first protection sleeve element 8 includes also a cylinder shaped portion 12 which is followed by a further substantially radially upturned annular end portion 13.

[0017] A second protection sleeve element 6 is located based on Fig. 1 at the right side of the apparatus, which sleeve element 6 includes a pipe stub element 7 extending inside the bellows 1 and coaxially thereto. This pipe stub element 7 is followed by a cylinder shaped portion 25 of the sleeve element 6, which cylinder shaped portion 25 ends at a substantially radially upturned annular end portion 17, i.e. this upturned end portion 17 has roughly the shape of circular ring positioned perpendicularly to the longitudinal axis of the apparatus.

[0018] The first protection sleeve element 8 projects at one end coaxially into the pipe stub element 7.

[0019] An annular envelope part 9 includes a cylinder shaped portion 10 which surrounds the cylinder shaped portion 12 of the first protection sleeve element 8. The cylinder shaped portion 10 ends also at a substantially radially upturned annular end portion 11 which will be described in detail further below.

[0020] A further annular envelope part 14 includes a further cylinder shaped portion 15. This cylinder shaped portion 15 surrounds the cylinder shaped portion 25 of the second protection sleeve element 6 and ends at a substantially radially upturned annular end portion 17.

[0021] As can be seen, the neck 2 of the bellows 1 is sandwiched between the cylinder shaped portion 10 of the envelope part 9 and the cylinder shaped portion 12 of the first protection sleeve element 8. In this embodiment these three parts are interconnected by a welding 18. Obviously, various kinds of weldings, e.g. spot welding, elongate welding seams, or other kinds of techniques such as riveting can be chosen for accomplishing this connection.

[0022] Likewise, the neck 3 at the opposite end of the bellows 1 is sandwiched between the cylinder shaped portion 15 of the envelope part 14 and the cylinder shaped portion 25 of the second protection sleeve element 6. Again, the interconnection of this embodiment is made by a welding 19.

[0023] Attention is now drawn to the left side of Fig. 1 and to Fig. 2. The upturned annular end portion 11 of the first envelope part 9 contacts the upturned annular end portion 13 of the first protection sleeve element 8. These end portions 11 and 13 form now together a flange structure 4 of the apparatus, i.e. one of its two flanges. The portions 11 and 13 can, but must not necessarily, be interconnected by a welding 20. In use, the apparatus will be coupled via this flange, i.e. flange structure 4, to a (not illustrated) adjoining pipe or other part of a plant, such as a pump. This coupling can be achieved by a variety of techniques. Here it shall be assumed that the coupling is made (according to a well-known technique) by a ring of a U-shaped cross section which is clamped over the flange structure 4 and the flange of an adjoining e.g. pipe, such that the flange structure 4 and the adjacent flange are inserted between the two legs of the U-shape. At its surface facing away from the bellows 1 the upturned annular end portion 13 which may be planar or may be deformed such to include as shown in this embodiment an annular recess 22. A sealing ring (not illustrated) can be placed into this recess 22.

[0024] The upturned annular end portion 11 of the left envelope part 9 extends at an acute angle relative to the upturned end portion 13 of the first protection sleeve element 8. This end portion has thus generally the shape of a truncated cone. It includes several recessed areas 24. Therefore, at its side facing away from the bellows 1 it is at the recessed areas 24 in surface contact with the upturned end portion 13 of the first protection sleeve element 8. These recessed areas 24 serve as abutment and as reinforcement of the upturned end portion 11. It should be noted that the two upturned portions 11 and 13 contact each other additionally along their circumference where they may possibly be welded together such as shown by the welding 20.

[0025] At its right side (according to Fig. 1) the apparatus, i.e. its components are of the same design as exemplified above regarding the left side. Thus, the upturned annular end portion 16 of the second envelope part 14 contacts the upturned annular end portion 17 of the second protection sleeve element 6. These end portions 16 and 17 form together the flange structure 5 of the apparatus and can, but must not necessarily, be interconnected by a welding 21. The recess in the upturned annular end portion 17 is identified by the reference numeral 23. The upturned annular end portion 16 of the second envelope part 14 extends at an acute angle relative to the upturned end portion 17 of the second protection sleeve element 6 and has again the shape of a truncated cone and includes recessed areas 26 forming abutments and reinforcements and being in a surface contact with the upturned end portion 17 of the second protection sleeve element 6. In this embodiment, these two end portions 16 and 17 are interconnected by

a welding 21.

[0026] Thus, it can be seen from the above detailed description of the preferred embodiment that the metal expansion joint and vibration absorber apparatus consists of thin walled interchangeable parts which are interconnected by weldings. Specifically to be noted is that the first protection sleeve element 8 and the second protection sleeve element 6 can be made of materials which differ from the materials of which the two envelope parts 9 and 14 which increases the versatility regarding a selection of materials. Therefore, the described apparatus is not only of an extreme light weight design but can be produced at low cost.

Claims

1. Metal expansion joint and vibration absorber apparatus, including

   - at least one metal bellows element (1) with a first neck (2) extending axially from one end and a second neck (3) extending from the other end of said bellows element (1);
   - a first (4) and a second flange structure (5);
   - a first protection sleeve element (8) comprising a cylindrically shaped portion (12) and a further continuous and substantially radially upturned annular end portion (13);
   - a second protection sleeve element (6) which includes a pipe stub element (7) located inside of and extending coaxially to said metal bellows element (1), in which a portion of said first protection sleeve element (8) is received, and includes further a cylindrically shaped portion (25) and a further continuous and substantially radially upturned annular end portion (17);
   - a first envelope part (9) having a cylindrically shaped portion (10) and a thereto continuous and substantially radially upturned annular end portion (11);
   - which upturned annular end portion (11) of said first envelope part (9) abuts the upturned annular end portion (13) of said first protection sleeve element, (8), whereby said two end portions (11, 13) form said first flange structure (4);
   - a second envelope part (14) having a cylindrically shaped portion (15) and a thereto continuous and substantially radially upturned annular end portion (16),
   - which upturned annular end portion (16) of the second envelope part (14) abuts the upturned annular end portion (17) of the second protection sleeve element (6), whereby these two end portions (16, 17) form said second flange structure (5);
   - which first neck (2) of said metal bellows (1) is sandwiched between and mounted to the cylindrically shaped portions (10, 12) of the first envelope part (9) and the first protection sleeve element (8);
   - and which second neck (3) of said bellows (1) is sandwiched between and mounted to the cylindrically shaped portions (15, 25) of the second envelope part (14) and the second protection sleeve element (6);

   characterized in that the substantially radially upturned end portions (11, 16) of said first envelope part (9) and said second envelope part (14) extend at an acute angle relative to the respective substantially radially upturned end portions (13, 17) of the first protection sleeve element (8) and the second protection sleeve element (6), and include a plurality of recessed areas (24, 26) and wherein the surfaces facing away the bellows (1) are in surface contact with the surfaces of the substantially radially upturned end portions (13, 17) of the first and second protective sleeve elements (8, 6) facing the bellows (1).

2. Metal expansion joint and vibration absorber apparatus according to claim 1, characterized in that the first and second necks (2, 3) of said bellows (1) are welded to the respective cylindrically shaped portions (10, 12; 15, 25).

3. Metal expansion joint and vibration absorber apparatus according to one of the preceding claims, characterized in that the substantially radially upturned annular end portion (11) of said first envelope part (9) is welded to the second substantially radially upturned annular end portion (13) of said first protection sleeve element (8), and the substantially radially upturned annular end portion (15) of said second envelope part (14) is welded to the substantially radially upturned annular end portion (17) of said second protection sleeve element (6).

4. Metal expansion joint and vibration absorber apparatus according to one of the preceding claims, characterized in that the substantially radially upturned annular end portions (13, 17) of both said first and second protection sleeve elements (6, 8) comprise an annular recess (22, 23) at radially extending surfaces which face away from the bellows element (1).

Patentansprüche

1. Kompensator- und Schwingungsdämpfervorrichtung aus Metall, enthaltend

   - mindestens ein Wellrohrelement (1) aus Metall, mit einem ersten Hals (2), der sich axial von ei-

nem Ende aus weg erstreckt, und einem zweiten Hals (3), der sich vom anderen Ende des Wellrohrelementes weg erstreckt;

- ein erstes (4) und ein zweites Flanschgebilde (5);
- ein erstes Schutzrohrelement (8), das einen zylinderförmig geformten Abschnitt (12) und weiter einen weiterlaufenden und im wesentlichen radial aufgebogenen Endabschnitt (13) aufweist;
- ein zweites Schutzrohrelement (6), welches ein Rohrstutzenelement (7) aufweist, das innerhalb des Wellrohrelementes (1) angeordnet ist und koaxial zu demselben verläuft, in welchem ein Abschnitt des ersten Schutzrohrelementes (8) aufgenommen ist, und einen weiteren zylinderförmigen Abschnitt (25) und einen weiteren fortlaufenden und im wesentlichen radial aufgebogenen ringförmigen Endabschnitt (17) aufweist;
- einen ersten Hüllteil (9), der einen zylinderförmigen Abschnitt (10) und einen dazu fortlaufenden und im wesentlichen radial aufgebogenen ringförmigen Endabschnitt (11 aufweist;
- welcher aufgebogene ringförmige Endabschnitt (11) des ersten Hüllteiles (9) am aufgebogenen ringförmigen Endabschnitt (13) des ersten Schutzrohrelementes (8) anliegt, wobei die zwei Endabschnitte (11, 13) das erste Flanschgebilde (4) bilden;
- einen zweiten Hüllteil (14), der einen zylinderförmigen Abschnitt (15) und einen dazu fortlaufenden und im wesentlichen radial aufgebogenen ringförmigen Endabschnitt (16) aufweist;
- welcher aufgebogene ringförmige Endabschnitt (16) des zweiten Hüllteiles (14) am aufgebogenen ringförmigen Endabschnitt (17) des zweiten Schutzrohrelementes (6) anliegt, wobei die zwei Endabschnitte (16, 17) das zweite Flanschgebilde (5) bilden;
- welcher erste Hals (2) des Wellrohres (1) aus Metall zwischen den zylinderförmigen Abschnitten (10, 12) des ersten Hüllteiles (9) und des ersten Schutzrohrelementes (8) eingesetzt und mit denselben verbunden ist;
- und welcher zweite Hals (3) des Wellrohres (1) zwischen den zylinderförmigen Abschnitten (15, 25) des zweiten Hüllteiles (14) und dem zweiten Schutzrohrelement (6) eingesetzt und mit demselben verbunden ist;

dadurch gekennzeichnet, dass die im wesentlichen radial aufgebogenen Abschnitte (11, 16) des ersten Hüllteiles (9) und des zweiten Hüllteiles (14) unter einem spitzen Winkel relativ zu den entsprechenden im wesentlichen radial aufgebogenen Endabschnitten (13, 17) des ersten Schutzrohrelementes (8) und des zweiten Schutzrohrelementes (6) verlaufen, und eine Mehrzahl vertiefte Bereiche (24, 26) aufweisen, und dass die vom Wellrohr (1) weg weisenden Seiten (1) in Oberflächenberührung mit den Seiten der im wesentlichen radial aufgebogenen Endabschnitte (13, 17) des ersten und zweiten Schutzrohrelementes (8, 6) stehen, die dem Wellrohr (1) zugekehrt sind.

2. Kompensator- und Schwingungsdämpervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass der erste und zweite Hals (2, 3) des Wellrohres (1) mit den jeweiligen zylinderförmigen Abschnitten (10, 12; 15, 25) verschweisst sind.

3. Kompensator- und Schwingungsdämpervorrichtung nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass der im wesentlichen radial aufgebogene Endabschnitt (11) des ersten Hüllteiles (9) mit dem zweiten im wesentlichen radial aufgebogenen ringförmigen Endabschnitt (13) des ersten Schutzrohrelementes (8) verschweisst ist, und dass der im wesentlichen radial aufgebogene ringförmige Endabschnitt (15) des zweiten Hüllteiles (14) mit dem im wesentlichen radial aufgebogenen ringförmigen Endabschnitt (17) des zweiten Schutzrohrelementes (6) verschweisst ist.

4. Kompensator- und Schwingungsdämpfervorrichtung nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass die im wesentlichen radial aufgebogenen Endabschnitte (13, 17) sowohl des ersten als auch des zweiten Schutzrohrelementes (6, 8) bei radial verlaufenden Flächenabschnitten, welche vom Wellrohrelement abgekehrt sind, eine ringförmige Vertiefung (22, 23) aufweisen.

Revendications

1. Joint métallique d'expansion et pour l'absorption de vibrations comprenant

   - au moins un élément métallique de soufflet (1) avec un premier collier (2) s'étendant axialement à partir d'une extrémité dudit élément de soufflet (1) et un second collier (3) s'étendant à partir de l'autre extrémité de cet élément de soufflet (1);
   - un premier flasque (4) et un second flasque (5);
   - une première manchette de protection (8) comprenant une partie cylindrique (12) et une partie intégrale annulaire (13) essentiellement relevée en direction radiale;
   - une seconde manchette de protection (6) comprenant un moignon de tube (7) situé à l'intérieur de l'élément métallique de soufflet (1) et coaxial avec celui-ci, une portion de la première

manchette de protection (8) s'insérant dans le moignon, et comprenant en outre une portion cylindrique (25) ainsi qu'une portion annulaire intégrale (17) relevée en direction radiale;

- une première enveloppe (9) avec une portion cylindrique (10) réalisée d'une pièce avec une portion terminale annulaire (11) essentiellement relevée en direction radiale;
- cette portion annulaire relevée (11) de la première enveloppe (9) touchant la portion relevée terminale annulaire (13) de la première manchette de protection (8) de manière à ce que les deux portions terminales (11, 13) forment le premier flasque (4);
- une seconde enveloppe (14) avec une portion cylindrique (15) réalisée d'une pièce avec une portion terminale annulaire (16) essentiellement relevée en direction radiale;
- cette portion terminale annulaire relevée (16) de la seconde enveloppe (14) touchant la portion annulaire terminale relevée (17) de la seconde manchette de protection (6) de manière à ce que les deux portions terminales (16, 17) forment le second flasque (5);
- le premier collier (2) du soufflet métallique (1) étant coincé entre et monté sur les portions cylindriques (10, 12) de la première enveloppe (9) et de la première manchette de protection (8);
- le second collier (3) du soufflet métallique (1) étant coincé entre et monté sur les portions cylindriques (15, 25) de la seconde enveloppe (14) et de la seconde manchette de protection (6),

caractérisé en ce que les portions terminales (11, 16) essentiellement relevées en direction radiale de la première (9) et de la seconde enveloppe (14) s'étendent à angle aigu par rapport aux portions terminales (13, 17) respectives essentiellement relevées en direction radiale de la première (8) et de la seconde (6) manchette de protection, et comprennent plusieurs régions en retrait (24, 26), les surfaces opposées au soufflet (1) étant en contact superficiel avec les surfaces faisant face au soufflet (1) des portions terminales (13, 17) essentiellement relevées en direction radiale de la première et de la seconde manchette de protection (8, 6).

2. Joint métallique d'expansion et pour l'absorption de vibrations selon la revendication 1, caractérisé en ce que le premier et le second collier (2, 3) du soufflet (1) sont soudés aux portions cylindriques correspondantes (10, 12; 15, 25).

3. Joint métallique d'expansion et pour l'absorption de vibrations selon une des revendications précédentes, caractérisé en ce que la portion terminale annulaire (11) essentiellement relevée en direction radiale de la première enveloppe (9) est soudée à la seconde portion terminale (13) annulaire essentiellement relevée en direction radiale de la première manchette de protection (8), et que la portion terminale annulaire (15) essentiellement relevée en direction radiale de la seconde enveloppe (14) est soudée à la portion terminale (17) annulaire essentiellement relevée en direction radiale de la seconde manchette de protection (6).

4. Joint métallique d'expansion et pour l'absorption de vibrations selon une des revendications précédentes, caractérisé en ce que les portions terminales annulaires (13, 17) essentiellement relevées en direction radiale de la première et de la seconde manchette de protection (6, 8) comprennent une cavité annulaire (22, 23) sur les surfaces s'étendant radialement orientées à l'opposé de l'élément de soufflet (1).

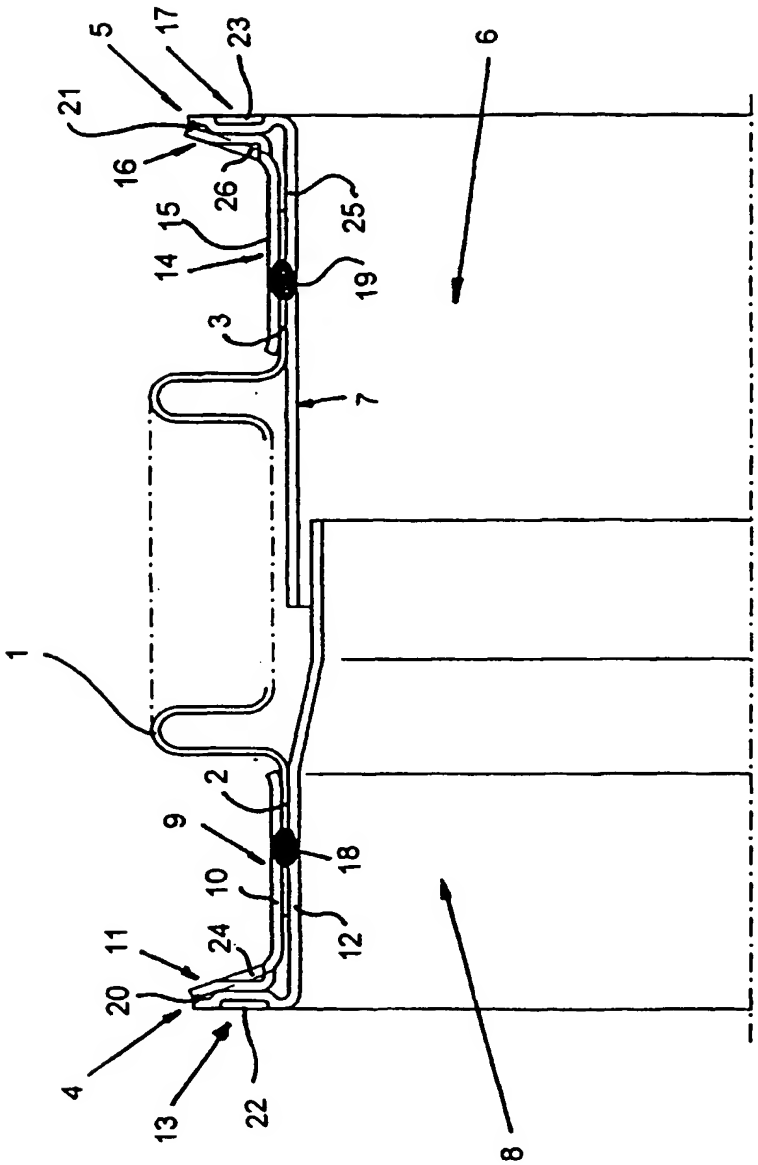


Fig. 1

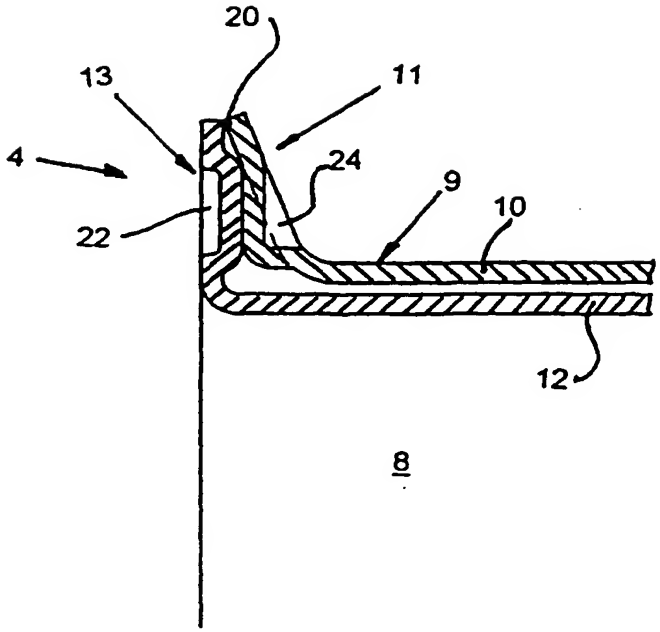


Fig. 2